Remarks:

Rejection under 35 USC §103(a)

The Office Action of 04 May 2005 has been carefully reviewed. These remarks and the associated declaration made pursuant to 37 CFR §1.132 (in the Appendix that follows) respectfully traverse all grounds for rejection. Claims 1-34 are pending in the application, and were rejected under 35 USC §103(a) as being unpatentable over Dykstra (U.S. Patent No. 6,770,874, "the '874 patent") in view of Mack et al. (U.S. Patent No. 6,831,272, "the '272 patent".)

A. The Cited References Are Not Prior Art

35 USC §103(c)(1) states:

> "Subject matter developed by another person, which qualifies as prior art only under one or more of subsections (e), (f) and (g) of section 102 of this title, shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the claimed invention was made, owned by the same person or subject to an obligation of assignment to the same person."

As noted in the supporting declaration of Mr. Jerald Dykstra, Director of Intellectual Properties at Epion Corporation, and sole inventor of the invention disclosed in the '874 patent, at the time that the claimed invention was made, and at all times subsequent thereto, the subject matter of the '874 patent and the '272 patent has been owned by or subject to an obligation of assignment to Epion (or its corporate predecessor of the same name.) Assignments of the cited references and the present application from the respective inventors to Epion have been recorded at the USPTO as follows: assignment for the '874 patent at Reel 012245, Frame 0509; assignments for the '272 patent at Reel 012439, Frame 0470; and assignment of the present application at Reel 015550, Frame 0588.

Furthermore, there have been no publications disclosing, public uses, or offers for sale of the '874 or '272 subject matter occurring more than one year before the January 27, 2003, filing

date of the provisional patent application (ser. no. 60/442,854) to which the present application claims priority.

B. The Presently Claimed Invention is Novel and Unobvious over the Cited References

(a) Submitted with the Appendix is a paper authored by the Applicant entitled "Measurement Of Averages Of Charge, Energy And Mass Of Large, Multiply Charged Cluster Ions Colliding With Atoms", *Nucl. Instr. & Meth. -B* (first published online on the Internet 18 March 2004, after the filing of the instant application and associated provisional application), that acknowledges discussions with the named inventors of the '272 patent and recognizes the need for more comprehensive measurements than provided by the simple time-of-flight (TOF) apparatus and techniques disclosed in the '272 patent. The introduction section of the Swenson paper, in particular, explains the inadequacies of simple TOF techniques such as in the '674 and '272 patents. Lines 99-110 of the paper (and par. [0006]+ of the instant application) describe the novelty of the presently claimed invention relative to simple TOF measurement.

In Mr. Dykstra's declaration (Appendix), he states the problems with simple TOF techniques were known to him (as inventor of the claimed invention of the '874 patent) and inventors Mack and Torti (inventors of the claimed invention of the '272 patent), but not resolved by any of them. He further avers that commercial apparatus and method embodiments of the presently claimed invention are now offered with each gas cluster ion beam processor that the assignee of the present application offers for sale.

(b) Neither the '874 patent nor the '272 patent, alone or in combination, teach or suggest *forming an attenuated sample of the cluster ion beam* or *calculating a measure of the average charge state.*

The instant Office Action asserts that the '874 patent "discloses methods and equations for measurements of various parameters of cluster ions in a cluster ion beam", however such "various parameters" are limited to:

1) the cluster size or mass (N or m_i) and/or the distribution of the cluster size or mass (N or m_i), but only for the special case of cluster charge state q =1 ('874, col. 8, line 63 through col. 9, line 19); and

2) in the more general case where q is unknown, only the parameter N' and/or its distribution, N' being the ratio cluster mass N to the unknown charge state q.

The '874 patent indicates that "at present there is no easy separation of these distributions", and, referring to N', "this generalization somewhat reduces the utility of the measurement." Such measurements are only precise when q = 1 or it has been arranged that q is very approximately 1 (col. 1, line 66 through col. 2, line 5.) N' is a useful parameter (col. 2, line 11-16) for beam and process control, but it is not a substitute for the actual charge q or charge distribution or the actual average charge $\overline{q}$ of the clusters. The parameter N' cannot distinguish between clusters of 1000 atoms having a single charge and clusters of 10,000 atoms having a charge state of 10. This is exactly the problem described in the instant application in par. [0007].

Neither the '874 patent nor the '272 patent teach or suggest how, when the charge state q of the clusters is unknown, to measure the average energy $\overline{E}$ nor the average mass $\overline{m}$ nor the average charge state $\overline{q}$ of the clusters. The '874 patent teaches how to measure the mass or mass distribution or by extension the average mass in the very special case where q = 1 or some other a-priori known value, and/or how to measure N' = N/q in all other cases where q is unknown, which is not equivalent to knowing $\overline{q}$ or knowing $\overline{m}$.

Applicant respectfully suggests that it is an error to assert (as is done in the instant Office Action) that "By using equations 1-3, the ratio of electric current to particle flow yields the cluster charge and.....", one that illustrates a key distinction between the presently claimed invention and the disclosures of the cited references. It appears that the Examiner believes that equations 1-3 can yield a cluster particle flow measurement, and that by combining that with a current measurement using a Faraday enclosure, the average cluster charge can be calculated. In fact, a cluster particle flow rate cannot be determined from equations or other teachings the '874 patent. That current measurement can be used (in the general case of unknown charge states q) to determine N' = N/q , but the total number N_C of clusters flowing or arriving in a unit of time cannot be determined and, thus, an average charge per cluster q(bar) cannot be determined. The

presently claimed invention uses a *beam attenuator* to create a sample of the beam, reducing the cluster flow or arrival rate to a level at which the individual cluster arrivals can be counted as discrete events enabling an independent measurement of cluster flow or arrival rate.

The Action states that "...their various ratios can readily be converted to their average values, for example, by simply repeating the measurements and taking their averages." However, the averages $\overline{q}$, $\overline{E}$, and $\overline{m}$ are averages across populations of cluster ions, not over time (they cannot be determined by repeating (in time) the measurement and averaging.)

Neither the '874 nor the '272 patents teach a *cluster ion beam attenuator*. Element 120 in each reference is a gas skimmer aperture that separates gas products that have not been formed into a cluster jet from the cluster jet so as to minimize pressure in the downstream region (e.g., see '874, col. 4, lines 44-47.) The skimmer has no purpose or intent to "attenuate" a beam, but rather is intended to fully transmit the cluster jet while blocking flow of gas that has not been incorporated into the jet by the nozzle. Such an element appears in the instant application in Figure 2 and par. [0029] as prior art. In the present application, beam attenuator 302 and attenuator aperture 303 are described as having a purpose of reducing the cluster flow rate within the beam to an accurately countable rate (par. [0040].) The use of an "attenuator" to permit accurate measurement of particle flow by direct individual counting of particles using a photomultiplier tube or other sensor is a novel feature of the present invention. The '272 patent does teach a beam gating device having open and closed states (col. 5, lines 55-58; item 212 in Figure 4; col. 7, lines 15-23) that controllably shuts off or restores the beam creating a transient for TOF measurement. Such operation is not attenuation consistent with the meaning of the present claims.

The instant Action also asserts that the '272 patent discloses " ... means for measuring an average energy per charge, $\left(\frac{E}{q}\right)_{average}$, of the cluster ions in the attenuated sample of the cluster ion beam; calculating means for processing measurements of $\left(\frac{E}{q}\right)_{average}$, flow rate, beam current

and average velocity, to calculate a measure of an average mass of cluster ions in the GCIB..." However, a reading of the '272 patent reveals no description or suggestion whatsoever of $\left(\frac{E}{q}\right)_{average}$ measurement. Only the transient of current in the Faraday when the beam is gated on or off is measured, from which a calculation determines a cluster size distribution f(n) and/or mass distribution (Eqn. 3; col. 10, lines 48-52), and only for the special case where the charge state of the beam is known or can be assumed to be q = 1 (col. 12, lines 19 – 41.) When the charge state is non-uniform from cluster to cluster, the calculation only determines the less useful distribution f(n/q).

In light of at least the foregoing, Applicant respectfully submits that the pending claims are in a condition for allowance, and a Notice to that effect is earnestly solicited. Please feel free to contact the undersigned with any questions that may remain at (617) 854-4000.

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Respectfully submitted,
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